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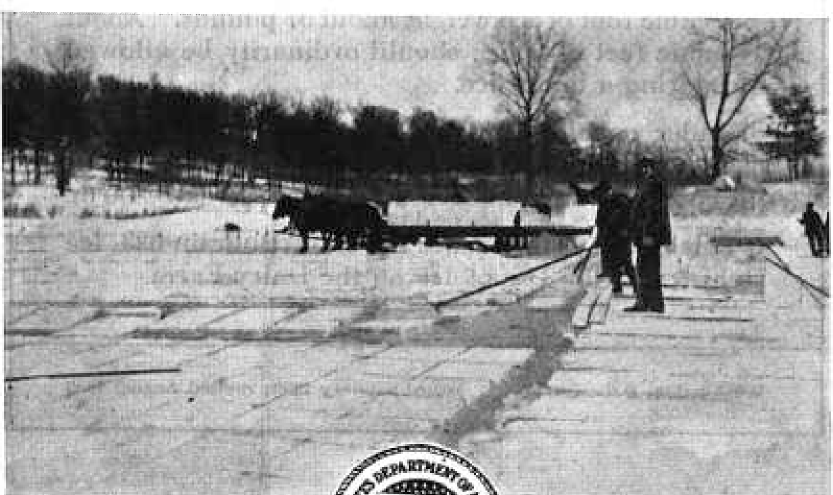
FARMERS' BULLETIN 1078
UNITED STATES DEPARTMENT OF AGRICULTURE

Harvesting and Storing Ice on the Farm



WHERE a stream of water or pond is available in the northern section of the United States, natural ice can be harvested and stored at low cost.

Care should be taken that the source of the ice supply is free from pollution and contamination.

Where very cold weather prevails in the winter and ponds and streams are not available, cakes of ice may be frozen in cans.

The space used for storing ice should accommodate about 50 percent more than is actually needed in order to allow for shrinkage.

A cubic foot of ice weighs about 57 pounds. About 45 cubic feet of space should ordinarily be allowed for storing a ton of ice.

Under usual circumstances about ½ to 1 ton of ice per cow for cooling cream or from 1½ to 2 tons for cooling milk is needed annually on a dairy farm.

This bulletin supersedes Farmers' Bulletin 623, Ice Houses and the Use of Ice on the Dairy Farm.

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HARVESTING AND STORING ICE ON THE FARM

By JOHN T. BOWEN, *senior electrical engineer, Division of Plans and Service, Bureau of Agricultural Engineering*

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SOURCES OF ICE

WATER for the ice supply should be investigated to make sure that it is free from contamination or pollution. Ponds and sluggish streams usually have grass and weeds growing in them and ice harvested from them may contain decayed vegetable matter, which is always objectionable and may be injurious to health. Such bodies of water should, therefore, be thoroughly cleared of such growth before cold weather. Green spawn and algae may be destroyed by the use of copper sulphate (blue vitriol). The crystals can be placed in a cloth bag which is hung on the end of a pole and trailed through the water until all the crystals are dissolved. One or two treatments during the summer at the rate of 1 pound of copper sulphate to 13,000 cubic feet of water will be sufficient to keep down such growths.

Streams or lakes are often polluted by sewage or other impurities that it is impossible to eliminate. A pure ice supply is especially important when the ice is to be used directly in beverages or other foods.

Throughout a considerable area of the United States natural ice is formed during the winter in sufficient quantity to warrant harvesting and storing it (fig. 1). In many areas of this region there are lakes, ponds, and streams from which ice can be harvested, while in other areas it is necessary to create artificially a body of water suitable for producing ice. This may be done either by diverting a stream into an excavation or by constructing dams across low areas. When it is necessary to construct artificial ponds the surface area is usually limited and several cuttings are ordinarily necessary to obtain the quantity of ice needed (figs. 2 and 3).

When cold weather prevails for several weeks at a time and the supply of pure water is limited, ice may be frozen in metal cans or special paper bags. The cans may be made in any convenient size by a local tinsmith and should be of galvanized iron reinforced at top and bottom with iron strips. The bottom is made smaller than the top, to make the removal of the ice easier. The cans are placed near the water supply, filled with water, and left exposed to the weather. A shell of ice soon freezes around the inner surface, and when the shell is from 1½ to 2 inches thick hot water is poured over the outside of the can and the shell removed. A hole is broken through the top of the shell and most of the water inside is poured out. As the freezing progresses water is poured into the shell a little at a time until a solid block of ice is produced. Under this method only a few cans are required, and this fact keeps the cost low.

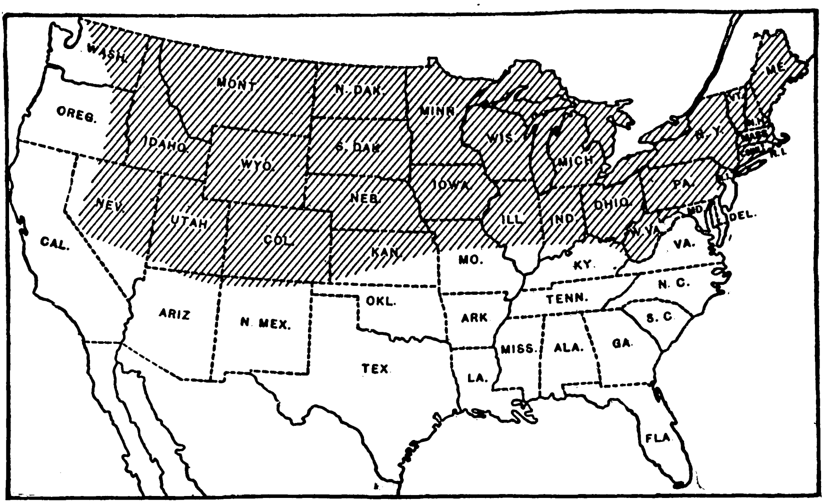

FIGURE 1.—Map of the United States, showing region in which natural ice may be harvested in normal winters.

Nearly the same method is employed in freezing water in special paper bags, although the bags do not last so long as the cans. The advantage of the bags over the metal cans is mainly their cheapness, for they are not so convenient to handle.

Another method that can be used in very cold regions is to run water into the ice house and let a layer freeze. This is done by first constructing a dam of snow around the floor of the house 10 or 12 inches inside the walls in order to allow sawdust insulation next to the walls. The interior of the house is then flooded with a few inches of water, which soon freezes, the procedure being repeated until the house is filled with ice. The ice is then covered with sawdust and the house closed up until the ice is needed. A great disadvantage of this method is that in order to remove ice it must be cut or chopped out with an ax, which results in uneven and irregular pieces and considerable waste of ice.

Floe ice is another source of natural ice. It is obtained in the spring when large pieces of ice float down from the headwaters of

streams and rivers. This ice is always broken up into irregular pieces and is not so easily handled and packed as that which is cut in regular shape.

FIGURE 2.—Artificial pond in yard.

QUANTITY OF ICE REQUIRED FOR A DAIRY FARM

The quantity of ice needed for a dairy farm depends on its location, number of cows milked, and methods of handling the product. In the Northern States it has been found that with a moderately

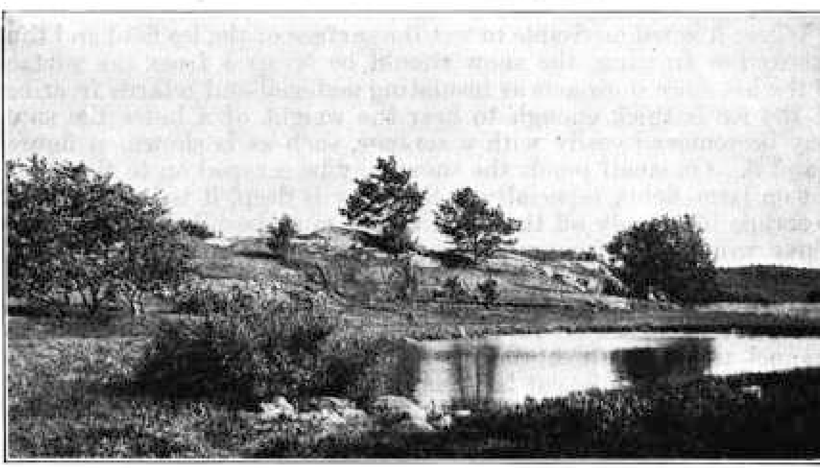

FIGURE 3.—Natural pond.

good ice house, where the shrinkage from melting is not more than 30 percent, half a ton of ice per cow is sufficient to cool the cream and hold it at a low temperature for delivery 2 or 3 times a week. It must be understood, however, that suitable cooling tanks are neces-

sary under this estimate. The half-ton-per-cow estimate for ice to be stored allows for a reasonable waste and also for ordinary household use. If whole milk is to be cooled, the quantity of ice stored must be increased to 1½ tons per cow in the North and 2 tons per cow in the South. To meet the needs of the average family on a general farm it will be necessary to store about 5 tons.

HARVESTING ICE

SIZE OF ICE FIELD

When the field is of sufficient size to fill the ice house at a single cutting, the thickness and quality of the ice are more nearly uniform and preparation for cutting and harvesting need be made but once. In many instances, however, the pond or stream is so small that it is necessary to wait for a second crop in order to fill the ice house. The number of square feet of surface required per ton with ice of different thicknesses is shown in table 1.

TABLE 1.—*Number of cakes of various thicknesses required per ton of ice*

[Cake 22 inches square]

Thickness of ice (Inches)	Number of cakes required per ton	Cutting space required per ton	Thickness of ice (Inches)	Number of cakes required per ton	Cutting space required per ton
		Square feet			*Square feet*
4	31.3	105.4	14	8.9	30.1
6	20.9	70.2	16	7.8	26.3
8	15.6	52.6	18	6.9	23.4
10	12.5	42.1	20	6.3	21.1
12	10.4	35.1	22	5.7	19.1

REMOVING SNOW FROM SURFACE

Where it is not advisable to wet the surface of the ice field and thus hasten the freezing, the snow should be scraped from the surface of the ice, since snow acts as insulating material and retards freezing. If the ice is thick enough to bear the weight of a horse the snow may be removed easily with a scraper, such as is shown in figures 4 and 5. On small ponds the snow may be scraped on to the shore, but on large fields, especially if the snow is deep, it is impracticable to scrape it entirely off the fields and it must be piled in windrows. These windrows, of course, occupy considerable space, so that it is necessary to allow for an increased area of ice.

The distance between the windrows depends upon the depth of the snow. It is advisable to run them at right angles to the main channel through which the ice is floated. The area between the windrows then can be cut back any distance from the main channel, whereas if they run parallel to the main channel only that portion of the surface between can be cut before opening another channel. As the weight of the windrows of snow is usually sufficient to make the ice on which it is piled sink beneath the surface of the water, it is advisable, in order to prevent the water from overflowing the cutting surface, to cut a deep groove, or to cut through the ice parallel to and on both sides of the windrows.

WETTING DOWN THE FIELD

Usually snow falls on the ice before it is thick enough to harvest. Since the weight of the snow has a tendency to sink the ice, advantage is sometimes taken of the layer of snow in forming ice. Holes

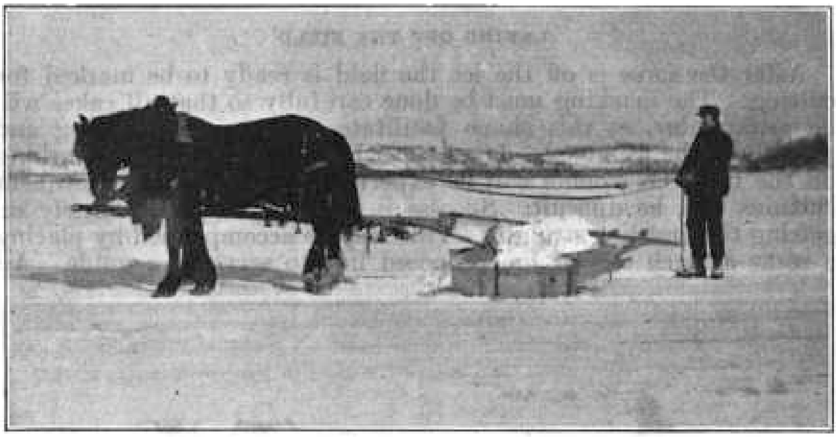

FIGURE 4.—Scraping snow from ice field.

are made in the ice, and water is allowed to rise through the openings and flood the surface. If the weather is very cold the mixture of snow and water quickly freezes and increases the thickness of the ice.

FIGURE 5.—Dumping snow from scraper.

The surface should not be flooded, however, unless the weather is cold enough to freeze the melted snow solid. If only the top surface of the snow freezes, a crust forms which makes scraping difficult and injures the quality of the ice. In that case it becomes necessary to

plane or scrape the crust of snow from the ice. The location and size of the holes for wetting down the surface should be planned so that the entire surface is completely covered with water. Ordinarily this is accomplished by small holes 1 or 2 inches in diameter and from 6 to 8 feet apart.

LAYING OFF THE FIELD

After the snow is off the ice the field is ready to be marked for cutting. The marking must be done carefully so that all cakes will be rectangular, as this shape facilitates economical handling and packing in the ice house. If a proper beginning is made in marking off the field, no trouble will be experienced; but if not, subsequent cuttings will be difficult. Success in marking depends largely on getting the first line straight. This may be accomplished by placing a stake at each end of the proposed line to serve as a guide. An

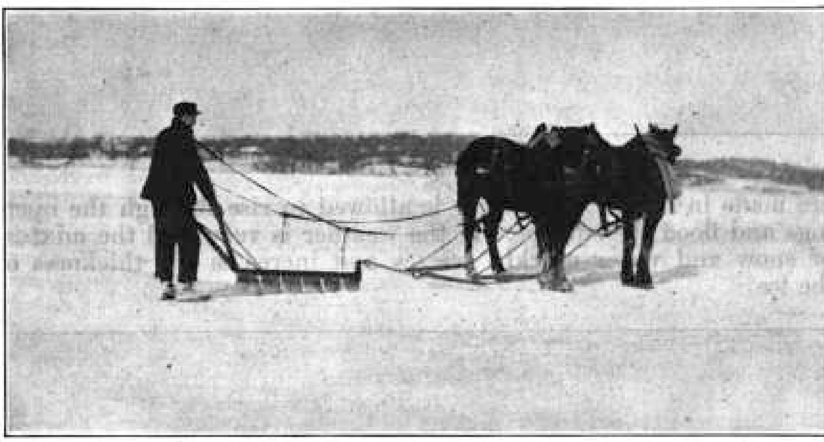

FIGURE 6.—Plowing ice.

ordinary board about 14 feet long is then alined with the two stakes and the cutting tool or hand plow run along its edge, after which the board is pushed forward and again alined with the two stakes. This is continued until the entire distance between the stakes has been covered. Another way is to stretch a line between the stakes and do the marking with a hand plow, but this method is not so satisfactory, because the hand plow cannot be run in so straight a line without the aid of the straightedge. After the first line is cut to a sufficient depth it can be used as a guide for the horse marker (fig. 6), if one is used.

After the field has been lined off in one direction the crosslines should be made. Care should be taken to have the crosslines at right angles to those first drawn; this is accomplished by the use of a square. A square suitable for the purpose can be made easily. First nail the ends of two boards together with a single nail. Measure a distance of 8 feet on the outer edge of one board and 6 feet on the outer edge of the other, then nail a third board diagonally across the two, adjusting it until the two marks are exactly 10 feet

apart on a straight line. The boards should then be nailed together securely, forming the desired square as shown in figure 7. If the first crossline is drawn with care, it is easy to draw the remaining lines parallel.

SIZE OF CAKES

The size of the cakes depends to some extent on the thickness of the ice, as well as upon tools available for harvesting, but in any case it is important to have all the cakes of the same size. In order to simplify the handling and packing many farmers, especially those who harvest a comparatively small quantity of ice, cut the

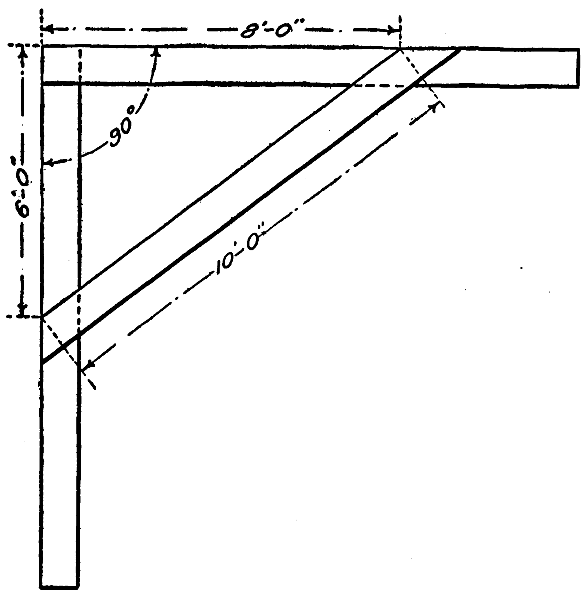

FIGURE 7.—Detail of square for marking off ice field.

cakes 22 inches square, a size that is easily handled with a limited amount of equipment. Table 1 gives the number of cakes 22 inches square and of different thicknesses required for each ton of ice.

From floe ice, which is always broken up, it is of course impracticable to obtain cakes of uniform size; consequently floe ice is gathered and packed as well as possible. The ice ax is used to remove irregular corners and the small pieces are used to fill the holes around the irregular pieces in order to make the whole mass as solid as possible and to reduce to the minimum the quantity of entrapped air.

CUTTING

After the field has been marked off, a strip of ice, one block in width (22 inches) and extending from the loading way to the main channel, is cut through and forced under the surface of the surrounding ice. This strip should be sawed somewhat wedge-shaped, wider at the bottom than at the top, thus allowing it to be forced down under the field with ease. The operation is known as "sinking the header" and opens up a small channel the width of the

proposed cakes. The channel is widened by cutting another strip to enable the long strips or floats of ice to be floated from the main channel to the bank or loading way.

FIGURE 8.—Sawing out floats.

FIGURE 9.—Cutting the ice.

The strips of ice are then pushed with an ice hook along the channel to the bank or loading way, where they are sawed or chopped into cakes (figs. 8, 9, and 10, and cover). The narrow channel, cut

at right angles to the main channel, has the advantage of allowing the operator to get closer to the cakes and to handle them more easily. At the end of the narrow channel there should be an inclined track or loading way up which the cakes are drawn either by hand or by a horse (figs. 11, 12, and 13). This track may lead directly into the ice house or to a platform from which the cakes are loaded upon a wagon or sled.

The cakes should not be cut completely through, but should be grooved 2 or 3 inches deep with the plow, floated up the channel, and chopped through with a special tool before being put on the loading way. This practice saves labor and time.

FIGURE 10.—Floating large cakes of ice to shore to be cut into smaller ones.

PACKING

The quantity of ice lost by melting depends partly upon the manner of packing. The cakes should be placed close together so that the mass will be as tight and solid as possible, thus preventing cracks and openings that will allow air to circulate. Perfectly cut rectangular cakes can be closely packed; this emphasizes the importance of special care in cutting to insure cakes of exactly the same size. When they are irregular in size the best plan is to fill up the openings with small pieces of ice. In order to insure close contact between succeeding layers no broken ice should be allowed to remain on top of or to protrude above the ice cakes.

Before ice is placed in the ice house a layer of dry sawdust about a foot thick should be placed in the bottom of the house, the depth of the sawdust being a few inches less in the center than at the outer edge, so that the cakes will have a tendency to slide toward the center instead of toward the walls. The sides of the mass of packed ice should be smooth. Any projecting pieces should be trimmed off before the ice is covered with insulating material. If sawdust or mill shavings are used, a space of at least 12 inches must be left

between the sides of the ice stack and the walls of the building. This space is filled with dry sawdust or shavings as the packing in the center proceeds.

In packing small quantities of ice it is a common custom to pour water over the mass of packed ice and allow it to freeze solid before

FIGURE 11.—Drawing ice cakes from water to loading platform.

putting the insulating material in place. While this undoubtedly assists in reducing the melting by closing the openings between the cakes, it has the disadvantage of making it more difficult to remove

FIGURE 12.—Harvesting and loading ice.

the ice when it is needed. It is then necessary to chop the cakes apart, which wastes considerable ice, so that little is gained in this way.

TOOLS REQUIRED

When only a small quantity of ice is to be harvested few tools are required. The following list includes those actually needed: Two ice saws, 1 hand marker, 1 pulley and rope, 2 pairs of ice tongs, 2 ice

hooks, 1 pointed bar or splitting fork, and 1 straightedge. Besides these essential tools, additional ones, such as a horse plow and marker, horse scraper, and a calking bar are convenient and will help to expedite the work. The amount of the equipment depends on the quantity of the ice to be cut and on local conditions for handling ice. If the harvesting must be done quickly, to take advantage of the weather, extra equipment will be justified. Neighbors may cooperate advantageously in cutting and storing ice and in owning equipment jointly.

COST OF HARVESTING ICE

The cost of harvesting ice differs with local conditions. It is impossible, therefore, to give an estimated cost that will cover all cases. The ice-harvesting season fortunately comes at a time when

FIGURE 13.—Loading cakes of ice on sleds to be hauled to ice house.

there is the least work on the farm for men and teams, and consequently the actual money cost is usually not very great. Investigations have indicated that counting the full value of the men's time, the average cost of cutting ice is about 3 cents for a cake 22 inches square and 14 inches thick, or about 27 cents a ton. Add to this the cost of packing and hauling, and the average cost of a ton of ice is about $1.50, when the ice house is near the source of supply. If the ice house is at a considerable distance the cost of hauling, of course, is increased, and the total cost of storing ice in some instances has amounted to $3 or more a ton.

ICE HOUSES

CAPACITY

A cubic foot of ice weighs about 57 pounds, so in storing ice it is customary to allow from 40 to 50 cubic feet per ton for the mass of ice, but the quantity that an ice house of a given size will hold de-

pends upon the manner in which the ice is stored. Generally a cubic foot of an ice house will hold the quantities given below:

	Pounds
Ice thrown in at random, about	30 to 35
Ice thrown in in irregular pieces and broken sufficiently to pack closely	35 to 40
Ice in cakes piled loosely	40 to 45
Ice in cakes piled closely and with very small crevices between cakes	45 to 50

Unless the ice house has permanently insulated walls, at least 12 inches between the ice and the wall of the building and an equal space beneath and above the ice must be allowed for insulation. From this it is possible to calculate readily the quantity of ice that any given house will hold. Thus, allowing 45 cubic feet per ton, an uninsulated ice house 18 by 12 by 10 feet high, allowing 1 foot around the ice for insulation, will hold about 28 tons, while an insulated house of the same size will hold about 48 tons.

Loss by melting is in proportion to the surface area exposed to the air or packing material; hence it is advisable to store ice in the form of a cube, or as nearly so as practicable. Table 2 gives the inside dimensions of insulated houses for various quantities of ice. For uninsulated houses each dimension should be increased 2 feet.

TABLE 2.—*Inside dimensions of insulated ice houses for various quantities of ice*

Quantity of ice	Length	Width	Height	Quantity of ice	Length	Width	Height
Tons	*Feet*	*Feet*	*Feet*	*Tons*	*Feet*	*Feet*	*Feet*
10	10	7	7	30	14	10	10
20	14	8	8	40	18	10	10
25	14	10	8	50	16	12	12

LOCATION

The selection of a site for an ice house is very important. Other conditions being suitable, the ice house on a dairy farm should be placed as near as possible to the milk house, in order to reduce the labor of handling ice and to encourage its more liberal use. On a general farm the ice house should be located near the residence. To facilitate drainage the ground on which the ice house stands should be porous and slope from the building. Advantage may be taken of hills, trees, or buildings, which often afford protection from hot winds and direct rays of the sun, thus saving ice.

TYPE OF CONSTRUCTION

The construction of the ice house depends to a great extent upon local conditions, the size of the house, and the difficulty of obtaining ice. These factors help to determine what sum may wisely be spent for such a building. Where ice is expensive or hard to obtain, a better constructed and insulated and therefore more expensive ice house is advisable. Where natural ice can be harvested and stored cheaply, a cheap structure is usually satisfactory and the loss from melting ice is a small consideration.

The cost of harvesting and storing, the interest on the money invested, and repairs and depreciation on the building are to be

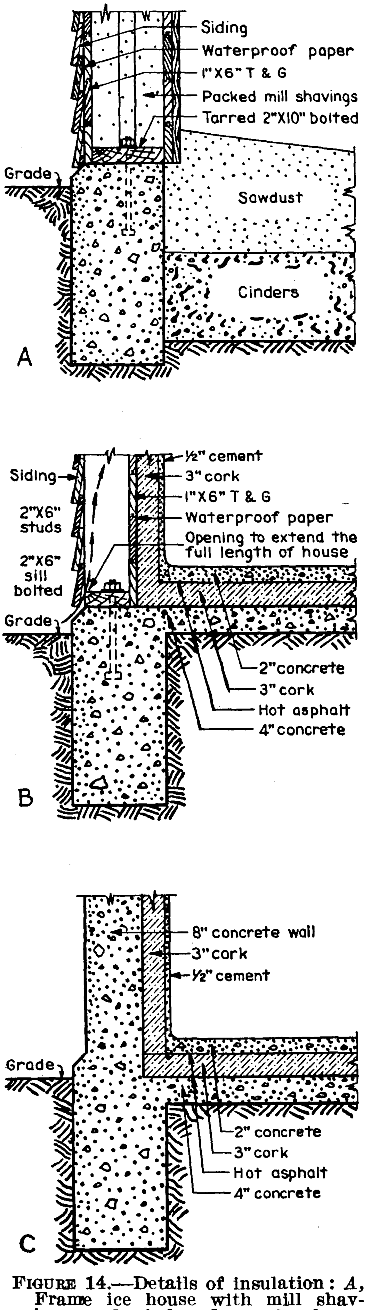

FIGURE 14.—Details of insulation: *A*, Frame ice house with mill shavings and cinder floor; *B*, frame ice house with commercial insulation and concrete floor; *C*, concrete or masonry ice house with commercial insulation and concrete floor.

considered in relation to the ice loss from melting; and the type of house to be built depends upon these factors. It never pays to build permanently in other than a substantial manner, and careful thought should be given the matter before erecting a cheap structure that may not give adequate service.

INSULATION

The object of insulation is to retard the passage of heat from the exterior to the interior of the building. No material known will entirely prevent the passage of heat, but several, called nonconductors or insulators, offer a high resistance to its passage (fig. 14). The best insulators appear to be those that contain entrapped air in the greatest number of small spaces. Their value also depends upon the density to which they are packed; if too loosely packed they will permit air circulation, if too closely they will cause the conduction of heat to a greater degree. Most of the materials in use give the best results when packed to a density of from 8 to 10 pounds per cubic foot.

Formerly in constructing buildings for the storage of ice or for cold storage, an air space as much as 12 inches wide was provided in the walls. It has been found, however, that an air space 1 inch wide is practically as valuable as one 12 inches wide. Air circulation is useful between the insulated ceiling and the roof of the ice house, for there it tends to break up the heat radiation through the roof. No openings in the ice chamber permitting entrance or exit of air, especially at or near the ground line, should be allowed in a building where ice is stored, as the cold currents of air tend to filter to the outside. If the walls and foundations are kept absolutely tight at the bottom an opening at the top has little effect, because the warm air entering remains at the

top of the room. When ice is to be removed from the house the door should be kept open as short a time as possible, and if a covering material, such as sawdust, is used, it is important to replace it after the ice has been removed. In a properly insulated ice house no covering for the ice is needed. It is merely packed on the floor of the room and depends on the insulated walls for protection from the outside heat.

In the cheaper ice houses, which do not have insulated walls, sawdust or mill shavings are commonly used to protect the ice. They are applied directly to the bottom, sides, and top of the ice stack. A layer of such material about 1 foot deep should be placed on the floor and the ice stacked upon it, a layer at a time. Ice will melt rapidly if placed directly on the ground, because moist ground is a fairly good conductor of heat.

For insulating the walls of frame buildings, planing-mill shavings are better than sawdust, because they are elastic, do not settle so readily, do not absorb moisture so rapidly, and are free from dirt, bark, and chips. When used as filling for walls or ceiling they should be well packed into place to prevent settling. Sawdust has been in common use for insulating because it usually could be obtained easily and at little or no cost. It has the disadvantage, however, of nearly always being damp, a condition which destroys its insulating value and favors the growth of mold and rot both in the sawdust and in the walls of the building. The rotting generates heat and also causes the sawdust to settle, thus leaving open spaces which further decrease the insulation. When sawdust is to be used it should be dried thoroughly before it is put into place. It can be dried by spreading it out about 6 inches deep and exposing it to the air and sunshine for a few days. Stirring will hasten the drying.

There are several kinds of commercial insulating material which are much more effective than either sawdust or shavings, and while their first cost is somewhat greater, in the end they are usually cheaper. Their insulating value is uniform, and moisture has little effect on them. In addition they are practically fireproof, occupy little space, and retain their efficiency a long time. Experienced workmen must install such material if best results are to be obtained.

DRAINAGE

Good drainage is essential for satisfactory ice storage. In houses where the floor is below the ground level enough drainage can usually be obtained through the soil if it is porous. With a clay soil it may be necessary to excavate a foot or two and fill the excavation with gravel or cinders or to place a tile drain under the floor. The drain should be trapped or sealed outside the walls to prevent warm air from entering the building through the floor. Dry soil affords better insulation than wet earth; hence it is advisable, where subsurface water is likely to keep the ground under the house damp, to lay a tile drain around the outside of the foundation walls. (Fig. 15.) In place of the tile a drain may be made of crushed rock and gravel, packed in a manner similar to that described under ice pits (p. 22).

As in the case of pits, the floor of the ice house should slope toward the center to keep the ice in a compact mass and to carry the water to the drain.

VENTILATION

Whatever the construction of the building, there is certain to be more or less melting that will cause moisture to appear on the walls and ceiling. If the building is of wood, the moisture is absorbed by the wood, and decay follows; wooden houses therefore should have a means of ventilation which can be controlled. A house equipped with commercial insulating material, covered inside with a cement finish, needs no ventilators from the ice chamber, but the building should be so constructed as to afford a circulation of air through the outer walls (fig. 14, B) and from the eaves to the ventilator on the roof (fig. 20). The resulting air currents tend to break up the heat radiation through the walls and roof.

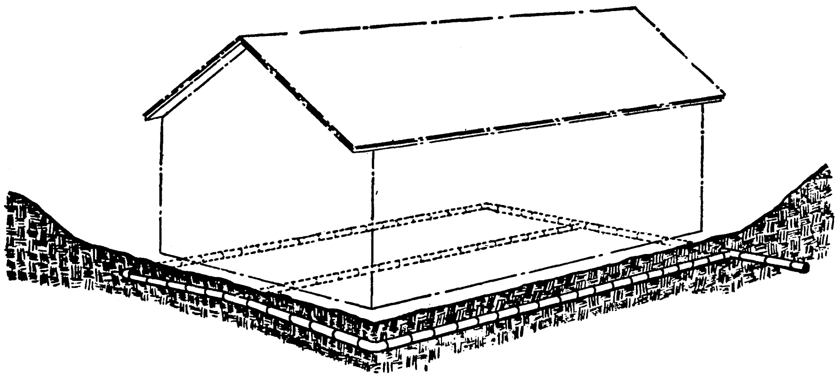

FIGURE 15.—Tile drain and foundation walls.

WATERPROOFING

It is of great importance that brick, concrete, and wooden buildings be waterproofed on the inside. Brick and concrete may readily be waterproofed by painting the walls with a suitable paint or waterproofing compound, such as preparations of paraffin and asphalt. Frequently paraffin and asphalt are melted and applied hot, in which case heating the walls facilitates their application. Several water-excluding paints and compounds for preserving wood are on the market. Creosote is considered one of the best preservatives, provided the wood is thoroughly impregnated with it, but on account of its odor it is objectionable in houses where food products are stored.

GENERAL SPECIFICATIONS FOR VARIOUS UNINSULATED TYPES OF ICE HOUSES

POST ICE HOUSE

Floor.—Consists of 12 inches of coarse gravel tamped into place as shown in figure 16.

Walls.—Posts are set up about 3 feet from center to center as indicated in figure 16, extending 3 feet into the ground and capped by a plate made of two pieces of 2-by-4-inch material; the inside is sheathed with 1-inch boards. The posts and boards below the ground should be treated with some preserving compound.[1]

Ceiling.—No ceiling is provided.

Roof.—The type of roof used is shown in figure 16.

Doors.—A door may be provided by cutting out the boards between two posts in the end of the house and closing the opening by placing short boards across on the inside and packing sawdust against them to keep them in place.

[1] For information on this process see Farmers' Bulletin 744, entitled "The Preservative Treatment of Farm Timbers."

Drainage.—Drainage is obtained by sloping the floor of the house so that the water will run to the center. A ditch should be dug as indicated, and filled with gravel and small stones. This ditch should empty outside at a point where there is sufficient fall to carry the water away. A draintile may be provided, as shown in figure 17. It should be properly trapped to prevent the entrance of warm air.

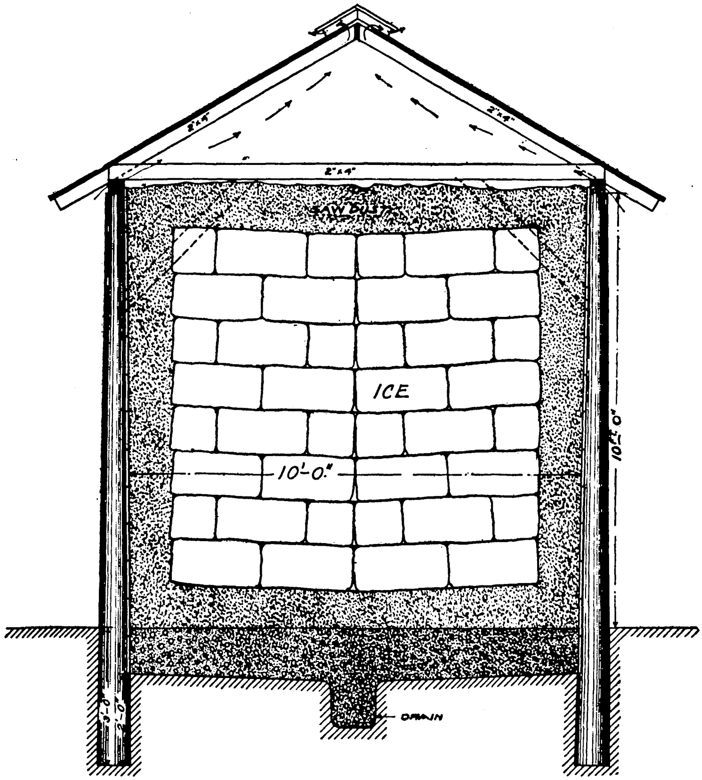

FIGURE 16.—Post ice house, uninsulated.

FRAME ICE HOUSE

Floor.—Consists of 12 inches of coarse gravel tamped into place, as shown in figure 17.

Walls.—On a 2-by-10-inch mudsill 6-by-6-inch sills are placed with 2-by-4-inch studs spaced about 2 feet center to center; on the inside of the studs 1-inch boards are nailed. The studding is capped as indicated. Both mudsills and sills should be treated with creosote.

Ceiling.—No ceiling is provided.

Roof.—The type of roof used is shown in figure 17.

Doors.—A door may be provided as suggested for the post ice house.

Drainage.—Drainage is provided by sloping the floor toward the center. Either a ditch such as is described for the post ice house or a draintile may be used to carry off the water. The same requirements are necessary as in the post ice house.

OPEN-TYPE ICE HOUSE

Figure 18 illustrates a small frame ice house such as is recommended by the Rochester (N.Y.) Health Board.

Floor.—Should consist of 12 inches of crushed stone or coarse gravel well tamped into place.

Walls.—The walls consist of 2 by 4 inch studs spaced about 2 feet center to center and erected on 6 by 8 inch sills. On the inner side of the studs are

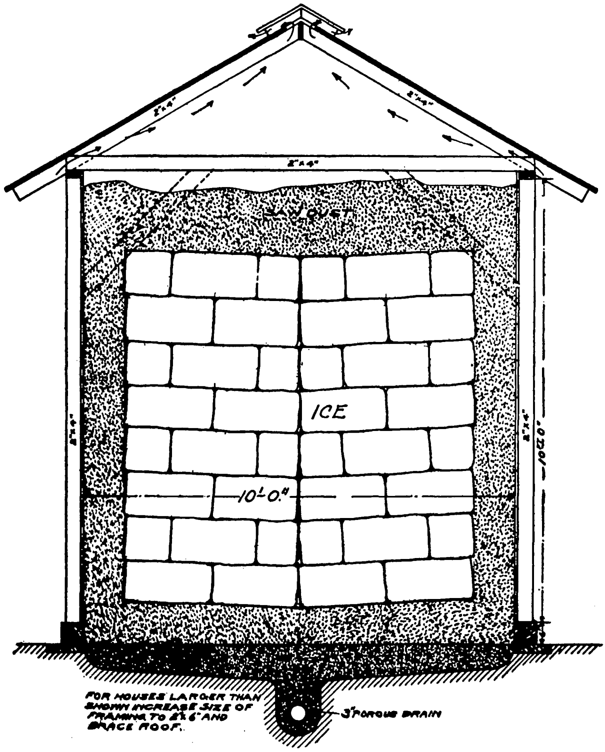

FIGURE 17.—Frame ice house, uninsulated.

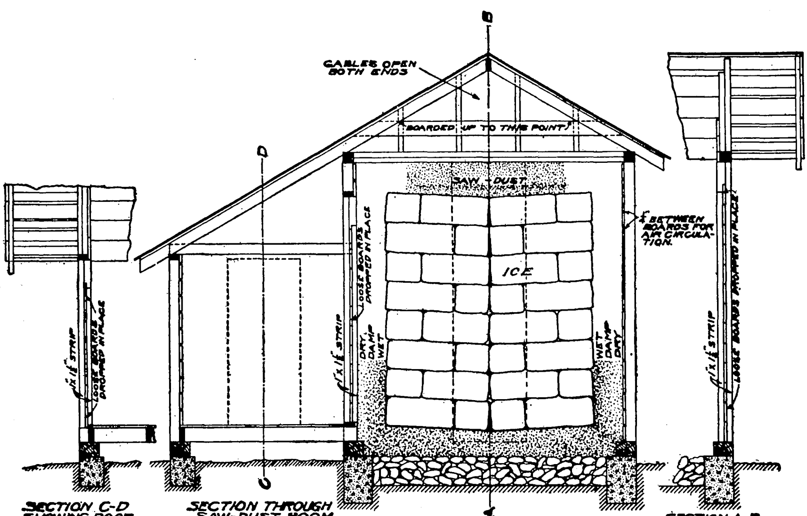

FIGURE 18.—Open-type ice house.

placed 1-inch rough boards with a ¼-inch space between. The object of the open construction is to dry out the outer layers of sawdust around the ice.

Ceiling.—No ceiling is provided. The gables are left open to permit circulation of air over the ice.

Doors.—Doors are constructed as shown and consist of loose boards dropped into place.

Drainage.—Drainage is provided by sloping the floor toward the center of the house. If the house is built on porous soil no drain will be needed; otherwise one of the forms of drainage described for the post ice house should be used.

Roof.—The roof is constructed as shown in figure 20 with an overhang of about 2 feet to prevent rain from blowing in on top of the ice.

Sawdust room.—A storage room for sawdust should be constructed as shown in figure 18.

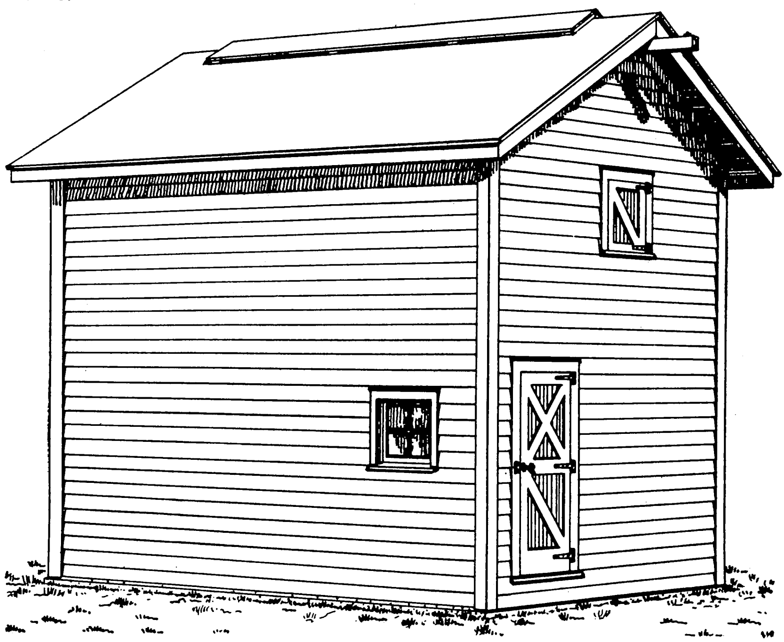

FIGURE 19.—Wooden ice house insulated with sawdust or mill shavings.

PERMANENT ICE HOUSES

A permanent ice house should be carefully and substantially built. Figures 19 and 20 illustrate the type of wooden house usually erected on farms. The vestibule and cooling room are features especially desirable on dairy farms but can be readily omitted where ice storage is the only objective.

Figure 14, A shows the method of building the wall of the house shown in Figure 19 so as to provide a cinder floor. Figure 14, B shows the use of commercial insulating material in a frame house while figure 14, C shows its use on masonry walls.

Screened openings should be built in the foundation walls around the vestibule and milk room to permit ventilating the space below the wood floor in order to prevent rotting of the timbers; these openings should not be built through the partition footing into the ice-storage compartment.

Foundations should be of stone or concrete mixed 1 part cement, 3 parts sand, and 5 parts gravel, and having depth sufficient to insure a solid bearing and protection from heaving caused by frost.

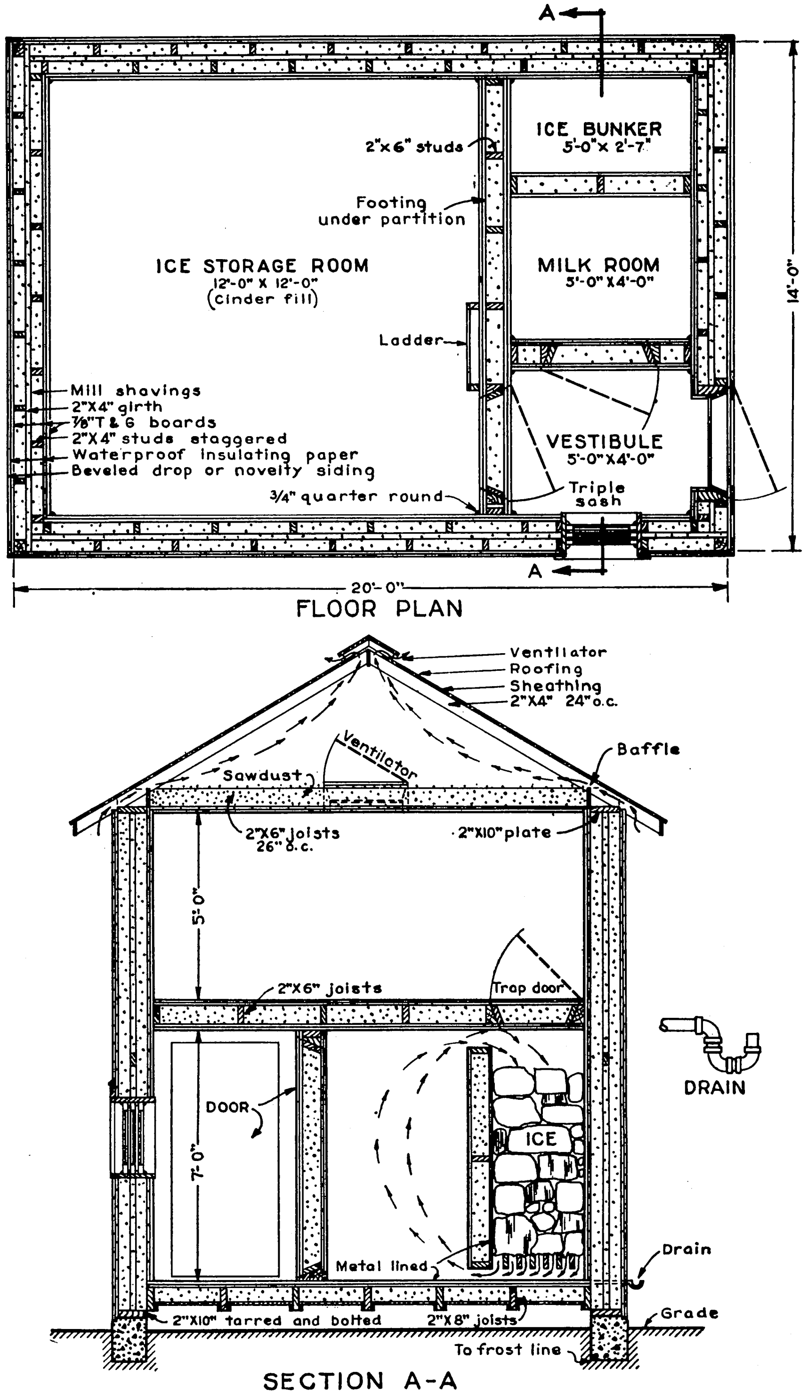

FIGURE 20.—Plan and section of house shown in figure 19.

When the floor is not to be paved with concrete, cinders should be used in preference to sand, gravel, or crushed rock to cover the ground area of the building. The cinders should be placed in a 12-inch layer and well tamped.

Ceilings should be built as shown in figure 20 but it is not desirable to provide the ventilators opening into the roof space if commercial insulating material is employed.

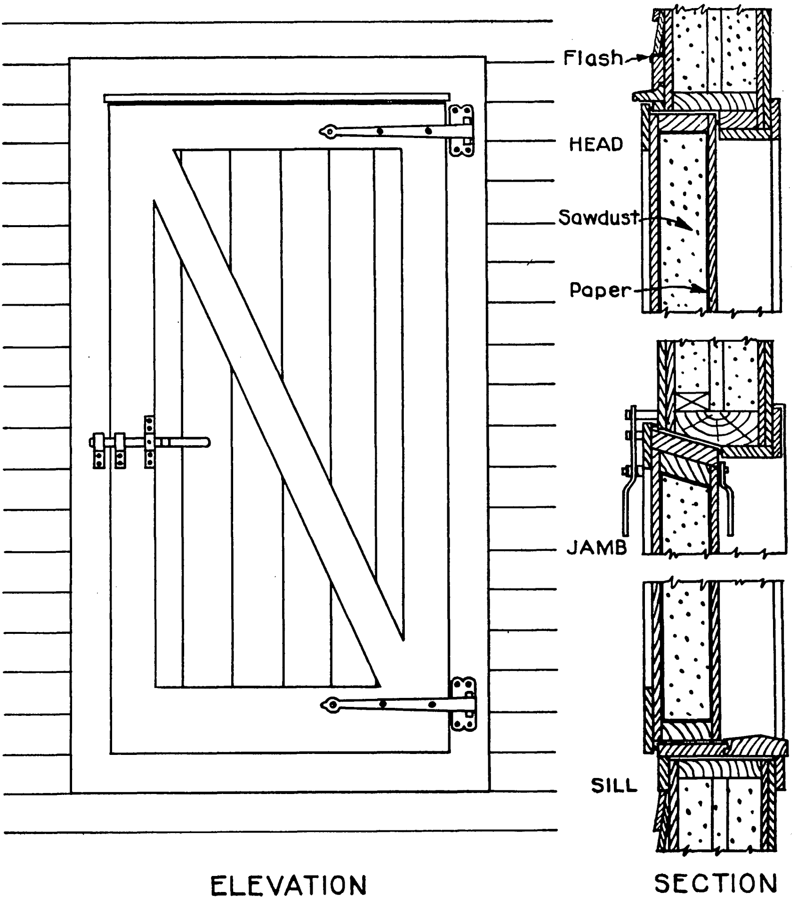

FIGURE 21.—Detail of service door.

Ordinary building paper is not satisfactory for use in ice houses—only heavy waterproof insulating paper should be used. Double thickness of paper is required in all cases, each layer lapping 6 inches over the preceding one. The layers should extend around all corners and breaks should be carefully sealed.

Doors should be constructed as shown in figure 21 and should be of good quality lumber. Commercial doors can be purchased at a reasonable price and probably will be more satisfactory than those made by a carpenter inexperienced in this kind of work. Continuous doors (fig. 22) facilitate filling and are built in addition to a service door. Where the milk room is a feature or when frequent entrance to the ice house is required a service door is very necessary.

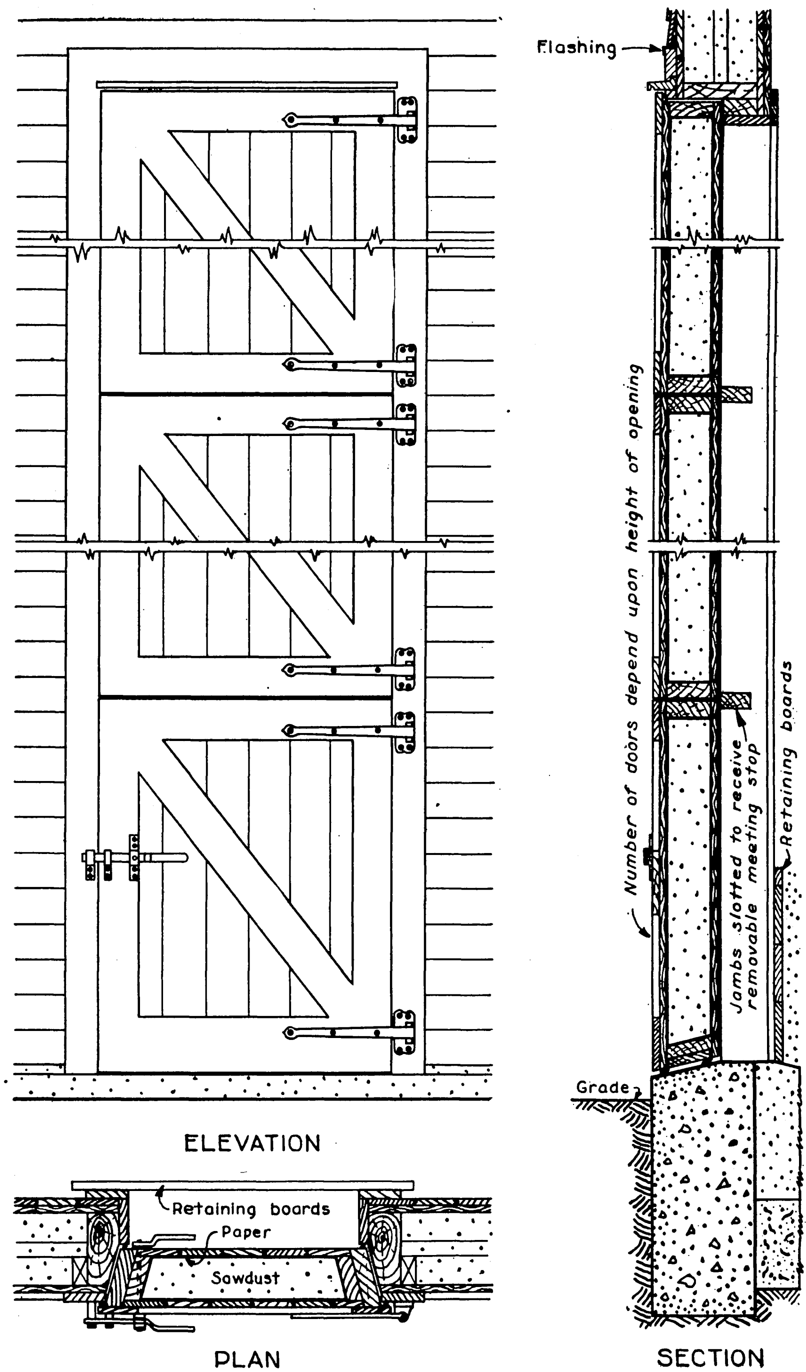

FIGURE 22.—Continuous door.

SMALL ICE HOUSES

Where it is desirable to store several tons of natural ice for family use or to hold a supply of manufactured ice for a short period in order to save frequent trips to the factory, the structure shown in figure 23 will be found convenient. The details previously given

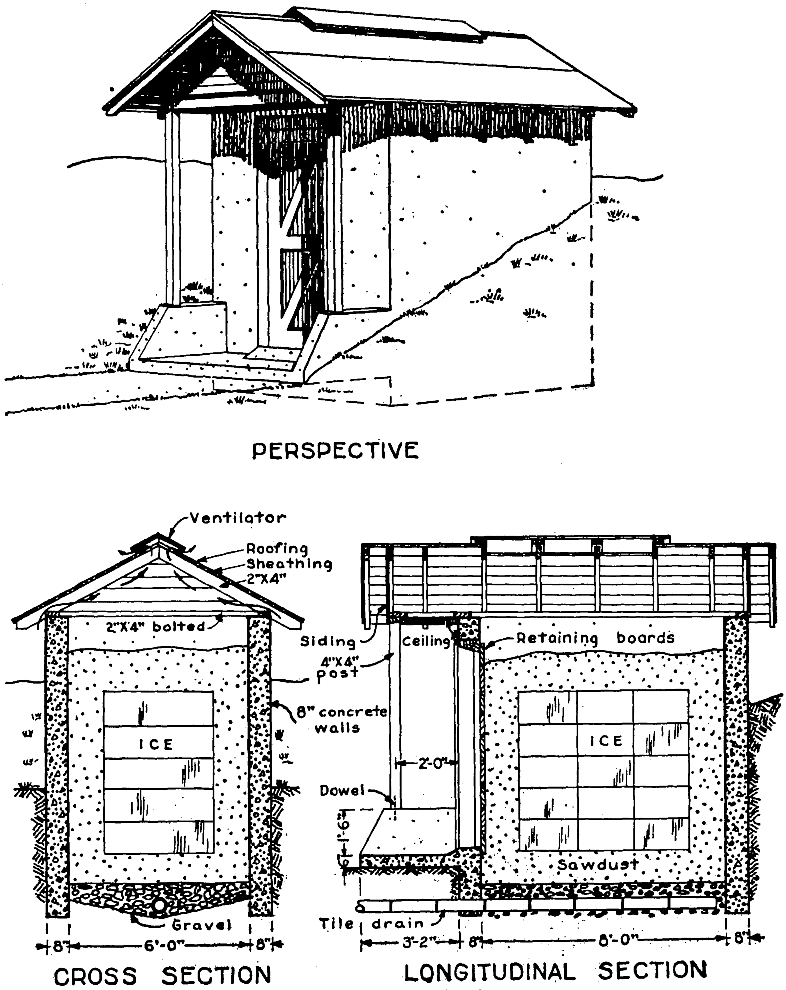

FIGURE 23.—Small ice house.

regarding building ice houses should be followed in erecting such a house. The concrete mixture[2] should be: 1 part cement, 2 parts sand, and 4 parts gravel or broken stone.

ICE PITS

If a suitable, well-drained location is available and only a small quantity of ice is to be stored, a pit may be used to advantage (fig. 24). The site selected should be sloping in order that a drain may

[2] For detailed information on concrete see Farmers' Bulletin 1279, Plain Concrete for Farm Use; and Farmers' Bulletin 1480, Small Concrete Construction on the Farm.

be placed under the floor of the pit. This drain may be of tile or may be simply a trench packed with small stones or gravel. If a tile drain is installed, it should be properly trapped to prevent the entrance of warm air into the pit. The trap should be placed outside the building where it will be accessible in case the drain becomes clogged. It may be placed where the drain discharges upon the ground, but as a stoppage may occur between the building and the trap it is better to place it close to the foundation wall. The trap should be of the handhole type with a terra-cotta stopper made air-tight with a light pointing of cement which may easily be removed

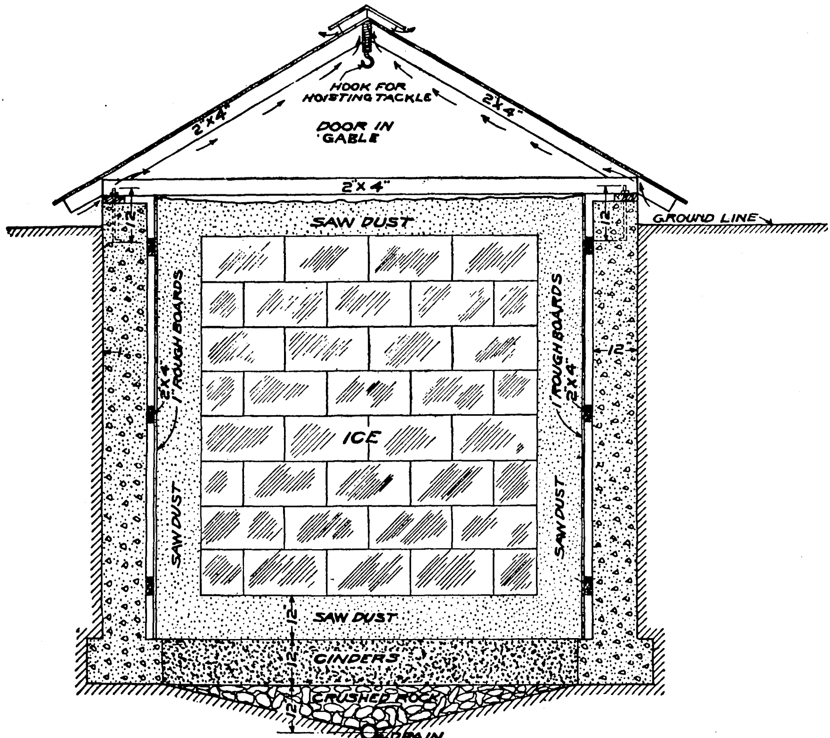

FIGURE 24.—Ice pit.

when necessary. The drain should not be laid near trees, as the tree roots will find their way into it, causing a stoppage in a very short time. Unless adequate drainage is provided the bottom of the pit will be flooded with water from melted ice or from seepage.

The floor of an ice pit should consist of 12 inches of crushed rock or coarse gravel tamped into place, and 12 inches of cinders, also well tamped, on top of the rock or gravel. The walls should be 12 inches thick, made of concrete mixed in the proportion of 1 part of Portland cement to 3 of sand and 5 of crushed stone or gravel. Walls should be waterproofed as suggested on page 15. No ceiling is required, and the roof may be constructed as shown in figure 24. A door in the gable or a hatchway through the roof will be needed.

Drainage inside the pit is provided by sloping the floor toward the center and having the water pass into the tile or gravel drain.

ICE CHEST

Frequently the farmer needs an ice box in which to store household provisions for short periods of time or to hold several cakes of ice as a supply for a small refrigerator. Figure 25 shows the essential points of construction of such a box. The inside dimensions will depend upon the size of box required. A 300-pound cake of ice measures about 11 by 22 by 44 inches. Allowing 4 inches more to facilitate handling the ice, the inside dimensions of a box to hold three cakes will be, assuming the cakes are laid flat, 26 inches wide by 48 inches long by 36 inches deep. If 3 half cakes are piled on

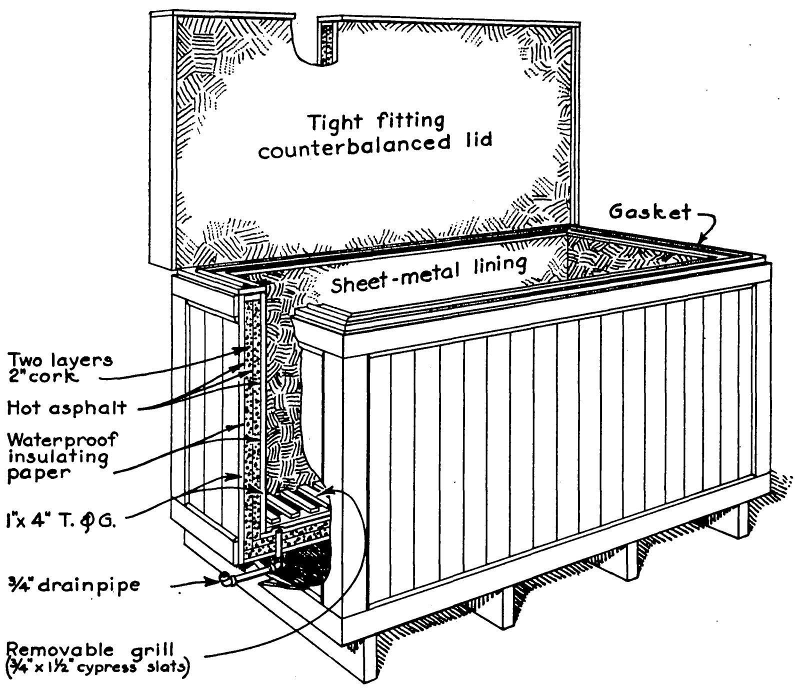

FIGURE 25.—Ice chest.

top of each other and 1 half cake is stood on edge, there will be space for two cakes of ice and 15 inches at one end for storage shelves. If three 10-gallon cans of milk are to be stored in addition to the ice, a width of 36 inches will be required.

Insulation equivalent to 4 inches of cork board should be provided. Other types of board insulating, or granulated cork, may be used by allowing for their thickness in the space indicated in figure 25 for the 4 inches of cork board. If cork board is used it should be installed in two layers of 2 inches each, care being taken to break all joints. Waterproof insulating paper should be installed as shown, primarily for preventing the entrance of air. The cork board should be covered on the sides with hot asphalt, but no asphalt should be applied to the edges. The drain should be effectively trapped to prevent air entering the box. The box and underside of cover should be lined with galvanized metal, either zinc or copper.

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